

AMATEUR SATELLITE REPORT

AMSAT's Newsletter for the Amateur Space Program.



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New Post-Eclipse Schedule Implemented On AO-10

As expected, a new transponder operating schedule was put into effect in early November (See ASR #108). However, after less than a week's experience with the new sked, it became apparent to satellite command stations that more battery charge time was required. Thus a revised, interim schedule was put into effect on 8 Sep by command station ZL1AOX.

The new schedule is as follows:

Mode B	040 - 105
Off	106 - 121
Mode B	122 - 189
Mode L	190 - 206
Mode B	207 - 220
Off	221 - 039

The omni antenna is now in use from 045 to 060.

The extra off period (106 to 121) was inserted on 8 Sep to increase the overall charging time compared to the preliminary schedule discussed previously.

This schedule will remain in place for at most a few weeks. As soon as possible, a further change will be made to increase operating times.

The objective attitude for the current epoch is 200 degrees longitude and -30 latitude. With changes coming frequently during this transition period, operators would do well to monitor the bulletins on the general beacon of Mode B, 145.810 MHz, for latest developments.

Short Bursts

- Richard Ensign of Dearborn Michigan has been named AMSAT Science Education Advisor. Richard directs a planetarium in the Dearborn Heights area of Michigan. Congratulations to this new volunteer!
- New 2-meter nets starting up include one in Derry, NH. Under the leadership of KG6LC, this Thursday evening net will meet at 9 PM on the Derry, 146.85 MHz repeater. N1DBB is backup NCS. Also, in the Chicago area, remem-

ber to tune in the AMSAT Net on Wednesday evenings on 147.285. NCS WD9IIC or K9NO are on hand to answer your questions and help you out. Net meets at 7:30 PM. The repeater requires a 1B PL tone to access.

- The Midwest Space Development Conference will be held at Miami University in Oxford, OH 27-29 September. Phone 216-282-6329 or write, Midwest Space Development Conference, 2720 West 40th Street, Lorain, OH, 44053.
- AMSAT has received an intriguing proposal to team on specific space development and spacecraft projects from the L5 Society. The L5 Society is a medium-size space activist organization based in Tucson, AZ. L5 is interested in participating in a spacecraft development program such as Phase 3C and would lend its space education and promotional expertise to AMSAT. A Memorandum of Agreement between the organizations is now under study.
- Continental Satellite of Clackamas, Oregon, makes parabolic dishes of various sizes (up to 30 feet) for commercial users and consumers alike. President Dan Berge, WA7BJU, and Randy Steggemeyer, W7HR, have recently told ASR that a special package of components for their excellent 5 meter (16 foot) dish is now available to amateurs at a very substantial discount. Contact Dan or Randy at 503-656-2774.
- Make reservations early at the Westin Hotel at Vail for the Third Annual Space Symposium and AMSAT Annual Meeting Nov. 9. AMSAT has a block of rooms and a special discount applies if you sign up early. Call 303-476-7111.



Top prize at the November 9 Annual Meeting and Awards Banquet will be this fabulous new ICOM 1271A all-mode 23cm transceiver. The meeting is slated for Vail, Colorado in conjunction with the Third Annual Space Symposium.

Sidereal Time Calculations For The "W3IWI" Orbit Program

by Dr. Tom Clark, W3IWI

The orbital prediction program I wrote a few years ago which was published in *ORBIT* magazine has been translated by a number of collaborators and made available through the AMSAT Software Exchange (ASE). Most of the ASE versions have a table of sidereal times at 00:00 on January 0 of each year which "expires" at the end of 1985. This *AMSAT Technical Note* will update this table for the entire period 1978-1999 using a more precise formulation than was used in the original program.

Recently the International Astronomical Union (IAU) adopted new astrometric constants for the based on the Julian day epoch Jan.0.0, 2000 (usually called "J2000") to replace the previously used Bessilian year 1950 (called B1950) constants. These calculations make use of the complete J2000 sidereal time series as published in the American Ephemeris and Nautical Almanac. Table 1 gives the J2000 Greenwich Mean Sidereal Times (GMST) for January 0.0 of each year. The BASIC program (written in Microsoft BASICA and run on an IBM-PC clone running MSDOS) which performed these calculations is given in Table 2. This program also includes a set of calendar utilities (to relate calendar day/day of year/day of the week/elapsed days since 1978.0) which may prove useful to others.

TABLE 1

Sidereal Time Calculations for January 0 at 00:00 UT de W3IWI on Sun 850825 = 85 / 237

Year	GMST		
78	0.27584815	89	0.27676777
79	0.27518504	90	0.27610467
80	0.27452194	91	0.27544157
81	0.27659675	92	0.27477847
82	0.27593365	93	0.27685328
83	0.27527055	94	0.27619018
84	0.27460745	95	0.27552708
85	0.27668226	96	0.27486399
86	0.27601916	97	0.27693880
87	0.27535606	98	0.27627570
88	0.27469296	99	0.27561260



Matt Long, N4MI and Ted Powers, W4FJ, set up this handsome AMSAT display at the recent Boy Scout Jamboree in Virginia.

TABLE 2

```

10 DEFDBL G-T : DIM DD$(21) : DD$ = "SunMonTueWedThuFriSat"
20 .....
30 '
40 ' This program computes Greenwich Mean Sidereal Time at 00:00z Jan 0.0
50 '
60 ' Calculations are based on IAU "J2000" constants for maximum accuracy
70 '
80 ' It also demonstrates a nice calendar subroutine that may be of some use
90 '
100 ' de W3IWI August 6, 1984
110 '
120 ' .....
130 '
140 PRINT "Sidereal Time Calculations for January 0 at 00:00 UT"
150 ' Get current date and print table header
160 DS=DATE$: Y=VAL(RIGHT$(DS,2)) : M=VAL(DS) : D=VAL(MID$(DS,4,2)) :
    GOSUB 1000
170 PRINT " de W3IWI on " : DW$:Y*10000+M*100+D : " = " : Y : "/" : DOY
180 PRINT : PRINT "Year", "GMST" : PRINT
190 ' LOOP TO COMPUTE Sidereal Time for Jan 0.0
200 FOR Y=78 TO 99 : M=1 : D=0 : REM -- Jan 0.0 of each year
210 GOSUB 1060
220 PRINT Y, : PRINT USING "0.#####", GMST
230 NEXT : STOP
1000 '
1010 ' .....
1020 ' --- Dates subroutine ---
1030 ' Input: Y = year (e.g. 83 for 1983)
1040 ' M = month
1050 ' D = day of month
1060 ' Output: DD = elapsed days since 1978.0
1070 ' DOY = day of current year
1080 ' DW$ = string with day-of-week
1090 ' GMST = Greenwich mean sidereal time in days at 00:00 UT
1100 ' STR = Sidereal time rate
1110 ' .....
1120 DX = INT((Y-1)*365.25) : DD=INT(D) : Y=INT(Y) : M=INT(M)
1130 IF M>2
    THEN DD = INT((M+1)*30.6) + INT(Y*365.25) + DD - 28553
    ELSE DD = INT((M+13)*30.6) + DX + DD - 28553
1140 DN = DD/7 : DN = INT(7*(DN-INT(DN))+.05)
1150 DW$ = MID$(DN,3*DN+1,3) : DOY = DD - DX + 28125
1160 GMST = DD * .00273790931# + DD*DD * 8.05975D-16 + .278586056#
1170 GMST = GMST - INT(GMST) : STR = 1.00273790931# + 1.61195D-15*DD
1180 RETURN
1190 '
1200 ' .....
1210 ' --- Inverse Date Subroutine ---
1220 ' Input: DD = Elapsed days since 1978.0
1230 ' Output: Y,M,D = year, month and day
1240 ' and alby Date subroutine
1250 ' .....
1260 ' -- first calculate Year=Y and Month=M
1270 Y = INT((DD+731)/365.25) + 76
1280 M = ((DD+28553-INT(Y*365.25))/30.6)+1
1290 IF (M>2.1 OR M>2.06 AND Y/4=INT(Y/4)) THEN M=INT(M) ELSE M=1
1300 ' -- now get the day of the month=D
1310 TEMP = DD : D = 1 : GOSUB 1000 : D = TEMP - DD + 1
1320 ' -- finally, re-calculate everything and exit
1330 GOSUB 1000 : RETURN
1340 END

```

[Editor's Note: ASR has received an excellent similar Sidereal Time analysis and table of values from Dr. Jack Cavanagh, KB4XF. Jack's values differ insignificantly from Tom's given above. We appreciate the fine work of both these experts. Where would we be without their work?]

Silicon Solutions Introduces New Tracking Software

Visitors to the First Annual Space Symposium at the Applied Physics Laboratory in Maryland in 1982 saw on display a remarkable special purpose computer built by Dick Allen, W5SXD, and Joseph Bijou, WB5CCJ, of Sugarland, TX. Now Dick and Joe have formed Silicon Solutions in Houston,

TX and introduced a very impressive pair of programs for the professional satellite analyst and advanced amateur alike.

Much of the number crunching accomplished in hardware in the prototype has been allocated to fast software processes in their new programs. Called GrafTrak and Silicon Ephemeris, these two programs provide capabilities never even closely approximated before on microcomputers. Only on large mainframes could the stunning graphics and fast, complex number crunching be accomplished. Running on an IBM PC or clone with the math co-processor, these programs have astonished virtually everyone who has viewed them. ASR will present a special product review on these programs soon. In the mean time, if you can't wait, check out the ad for Silicon Solutions in September QST, page 100 and/or call them at 713-661-8727.

ESA Loses Ariane Launcher, Two Satellites; Insurance Industry Teeters

ESA, the European Space Agency, lost an Ariane launcher to a failure on 12 Sep. Details were sketchy at press time but early reports suggested a third stage failure and a subsequent destruct command by the range safety officer when the seriously off-course launcher threatened a populated area. Two major satellites were aboard. This was the third failure of the Ariane in 15 launches and ended a string of 9 successful launches.

The battered space insurance industry, shuddering under the weight of losses in the hundreds of millions of dollars may virtually collapse with these latest losses. Last week the Syncom 4 satellite launched by shuttle mission 51I only the week before suffered a total loss of its UHF transponder for unknown reasons. Insurance premiums had zoomed to nearly 20% recently if a carrier could be found. Industry sources now expect even higher rates if any insurance can be obtained at all.

DARC Spacelab Ham-In-Space Mission Details

The German Amateur Radio Club, DARC, will fly a Ham-In-Space mission aboard the space shuttle this autumn as reported previously in these pages. Flying aboard Spacelab Mission D1, two German and one Dutch astronaut ham will use an FM, Mode B type transponder to communicate with hams around the world. The following details were recently supplied AMSAT by DARC via ARRL. The following is an excerpt from the DARC 5 Jul 85 document by the DARC working group comprising DL5MH, DL2MDE, DH1BAS, DC0BV and DF5KJ.

During the 7-day Spacelab Mission D1 in October 1985, the science astronauts R. Furrer, DD6CF and E. Messerschmid, DG2KM [and Dr. Wubbo Ockels, PE1LFO] will operate a ham radio station, located in the Spacelab on board the Space Shuttle *Columbia*. The call sign of this station will be DP0SL.

This ham activity is planned to start on mission day 3 and

to last until about 12 hours before landing. Therefore, about 5 days may be available, with which the astronauts can be active as radio amateurs within their [free time]. Exact information on possible contact times for interested ground stations depends on mission parameters and will be given in due time. As a rough guess, 6 shuttle passes with a maximum of 12 minutes of possible contact time may be expected per day.

This ham radio activity will be focused on Europe. However, it is intended to attempt contacts also in other parts of the world, as far as mission parameters, attitude of the spacecraft for instance, permit such attempts.

Calls of responding ground stations will be recorded on tape, evaluated after the end of the mission and confirmed with special QSL card by the DARC.

In times of no voice communication of the astronauts, the rig may operate as a recording beacon, i.e. an automatic CQ call will be transmitted, followed by a one minute period, in which the receiver records incoming calls on tape. This cycle is automatically repeated. Calls identified on tape will also be confirmed by DARC.

Finally, the transmitter may be operated as a normal beacon, i.e. continuous transmission with inserted callsign, but without receiving periods. This mode may be used for VHF wave propagation measurements.

TECHNICAL INFORMATION:

2.1 Equipment on board

The ham-rig on board the Spacelab consists of the following items: VHF/UHF Transceiver, Antenna, DC/DC Converter, Various cables, Headset Container with 10 micro-cassettes

2.1.1 VHF/UHF Transceiver

The VHF/UHF transceiver is a *special development, designed and constructed* by BOSCH/Germany according to the D1-mission specifications, and using components out of the normal mobile transceiver program of BOSCH.

RF power output of this transceiver is 10 watts. This output is reduced to 1 watt for automatic (beacon) operation. Frequency range of transmitter: 144 to 146MHz, modulation: F3e (FM).

The receiver is a double-superheterodyne receiver, frequency range 430 to 440 MHz. Sensitivity for S+N/N=12dB is 0.45 microvolts.

Selection of operating frequencies is provided by a ROM, programmed for 4 VHF transmitting frequencies and 6 UHF receiving frequencies within a 25 kHz channel spacing.

The transceiver is provided with a built-in micro-cassette recorder.

2.1.2 Antenna

The antenna has been designed and constructed by a group of radio amateurs at the antenna labs of the University of Bremen. This special antenna, to be mounted outside the Spacelab, is an aluminum whip antenna with a length of approximately 50cm. It shows quarter-wave resonance for VHF and 5/8 λ resonance for UHF.

2.1.3 DC/DC Converter

Electrical power (28 volts DC) is applied to the transceiver from the Spacelab utility power lines via a DC/DC Converter, to provide line isolation from ground.

2.1.4 Headset

For audio input and output, a lightweight headset from SIEMENS is used. It contains an earplug and a microphone with preamplifier, power for the latter being taken from the transceiver.

2.2 Equipment necessary for ground stations

To operate the Spacelab ham radio station, normal VHF and UHF amateur equipment is sufficient, if this equipment is capable of FM, split frequency operation on the frequencies given in the table in annex 5.1.

It is recommended to use circular polarized antennas, adjustable in horizontal and vertical direction. The maximum velocity, necessary to follow the Spacelab's orbit is approximately 1.5 degrees per second. At least for receiving, manual control of the antennas is sufficient, since only low gain antennas (gain 3 dB) are required to receive the signals of the Spacelab ham radio station.

An effective radiated power (EIRP) of 10 dBW is recommended for contacts with Spacelab. This means, for instance, that a 70cm-transmitter with 10 watts of power output combined with a 10dB gain antenna will be a good choice.

3. OPERATION

3.1 Installation on board Spacelab

Installation of the ham radio rig on board Spacelab is planned for mission day 2. The equipment will be unstowed from its dedicated stowage container, and mounted at rack 12. Cabling will be accomplished between the antenna feedthru in the aft vent plate of Spacelab and the transceiver antenna connector, between transceiver and DC/DC-Converter, and from DC/DC Converter to the utility power outlet on rack 10 or 8. Connecting the headset and inserting a micro-cassette into the recorder complete the installation procedure.

3.2 Testing

Testing of the ham radio rig is planned for mission day 3. The astronauts will call service stations in Germany in order to receive operational reports. These operational reports will exclusively be given by the German service stations DF0VR (Oberpfaffenhofen), DF0LRK (Cologne) and DK0UB (Bremen).

After sufficient contact reports from these service stations, the test procedure is completed.

3.3 Normal Operation

For normal operation, the astronauts can use either one of the following operating modes:

1. Ham rig "OFF"
2. Beacon-operation with inserted call sign, no receive.
3. Beacon-operation with automatic recording of incoming calls. In this mode, the transceiver transmits a CQ-call in Morse Code (F2): "CQ de DP0SL record on tape K", followed by one minute receiving time with automatic recording of calls on tape. Calls have to be made in f3e (FM voice).
4. Two-way voice QSO operation in F3e.

Selection of transmitting and receiving frequencies is exclusively with the astronauts. Frequencies and operating modes will be chosen by them according to the actual situation.

The normal channel-pair will be 3/3 (145.575 MHz transmit / 437.275 receive). However, in case of strong pile-up the astronauts will change their receiving frequency without notice. In such cases, ground stations have to choose one out of six uplink frequencies with equal contact likelihood, and the pile-up for the astronauts, as a consequence, will be reduced by a factor of 6.

For operational information between the astronaut-radio amateurs and ground amateurs, exclusively the 3 service stations will be used. For this kind of traffic, special procedures have been implemented.

4. INFORMATION SERVICE

Prior to the mission, all necessary information will be published in Germany in the CQ-DL magazine and the "DL-Rundspruch". Such information items are, for instance

Modifications of the operating concept, according to the latest knowledge about the mission.

Information on the correct way to communicate with the amateurs aboard the Spacelab ("Codex of procedure").

Expected contact times, according to the latest information on the project.

During the mission, the service stations in Oberpfaffenhofen and Cologne will on 80m and 2m, and in Bremen on 2m issue daily information on the mission. The content of these transmissions will be the same, except for the orbit data, which are corresponding to the locations of the respective stations. Examples for the content:

Forecast of expected contact times for the next day.

Orbit data hereto for Oberpfaffenhofen, Cologne and Bremen.

Other matters of special interest, concerning operation.

These transmissions (duration ca. 15 min.) will be followed by confirmation traffic. Confirming stations will be supplied with the special QSL card.

The transmissions of the service stations will be multiplied by selected, additional stations, in order to obtain an as complete as possible coverage of Germany and neighbor countries even on the 2m band. Up to today, no information service has been [planned] for outside Europe. However, it is intended to provide information on 20m. Proposals are welcome.

5. ANNEX

5.1 Technical Data of the Rig

Transmitter

Name	Ham Radio TX
Type	Bosch D1
Channel frequencies	see table
Channel spacing	25 kHz
± Frequency deviation (kHz)	6.2 (voice) 3.0 (beacon)
Modulation frequency, voice	0.3 to 3.0 kHz
Modulation frequency, beacon	1 kHz
RF power output, voice	10.0 watts
RF power output, beacon	1.0 watts

Receiver

Name	Ham Radio RX
Type	Bosch D1
Channel frequencies	see table
Channel spacing	25 kHz
Sensitivity (µV)	0.45 for S+N/N = 12 dB

Table of frequencies

	Transmit	Receive
Channel 0	145.450 MHz	437.125 MHz
Channel 1	145.475 MHz	437.175 MHz
Channel 2	145.550 MHz	437.225 MHz
Channel 3	145.575 MHz	437.275 MHz
Channel 4	—	437.325 MHz
Channel 5	—	437.375 MHz

Selection of transmit and receive frequencies is separately. There are no dedicated frequency-pairs, except for channels 3/3 (normal operation without pile-up).

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